

# E-951 TARGET HARDWARE

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E-951 Collaboration for Targetry Design  
Brookhaven National Laboratory

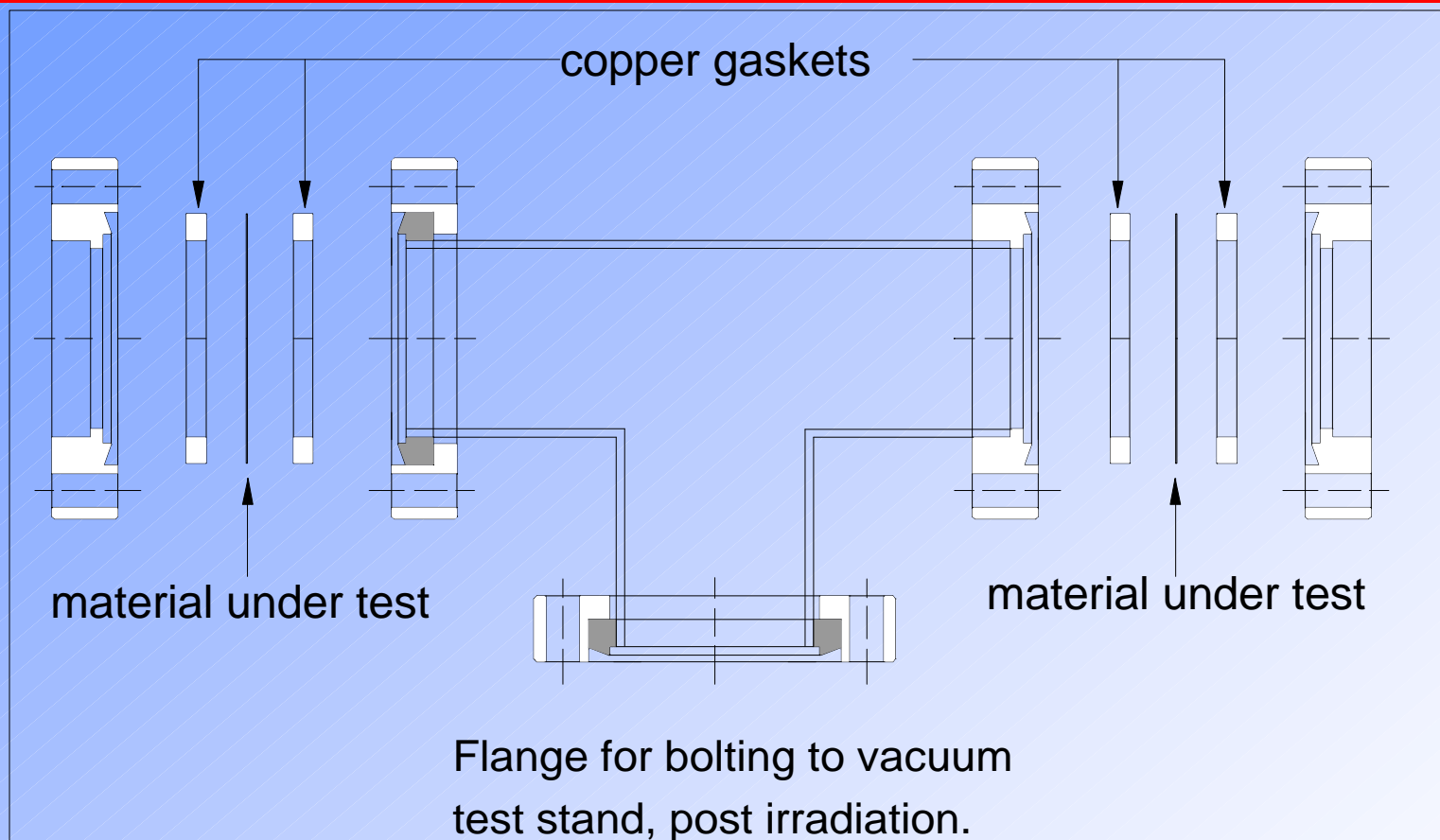
January 5, 2001

# Beam Window Material Evaluations

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- Prior to use of mercury targets, beam window materials need to be evaluated.
- A simple fixture is needed to allow candidate window materials to be exposed to beam.
- The proposed approach:
  - Assemble materials on a Conflat type 2.73" tee, rough pump down, valve off, and measure a leak rate.
  - Let up to air, and expose to prescribed number of beam pulses.
  - Rough down again, valve off, and compare the leak rate to previous measurement.

# Beam Window Material Test Fixture



E-951 Muon Muon Collider Targetry

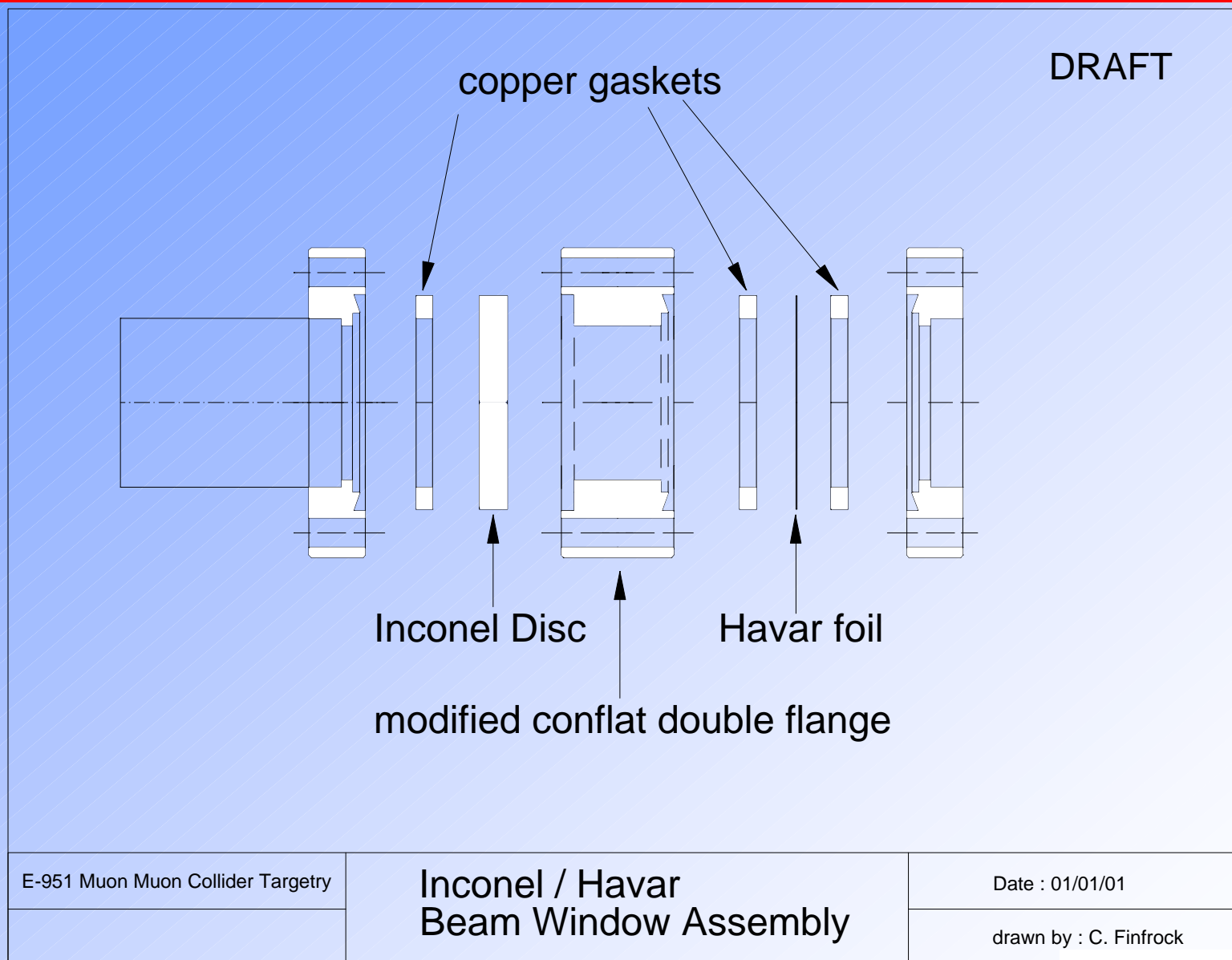
**DRAFT**

**Beam Window Test Fixture**

Date : 1/4/01

drawn by : C. Finrock

# Inconel / Havar Beam Window Assembly



# Mercury Target Requirements

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- Generate a one cm. diameter arcing horizontal jet of mercury to provide a 10 to 15 cm interaction length with the proton beam.
- Provide an unobstructed view of the interaction zone for high speed imaging.
- Operate simply, reliably and remotely.
- Safely contain projectiles which may be generated by mercury-beam interactions
- Manage mercury vapor generation
- Mounting system to provide for easy interchange of other test targets
- Materials of construction must be compatible with mercury and survive a radiation environment.



# Main Features of Pneumatic Mercury Jet Apparatus (1)

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- Mercury jet containments:
  - dual containment assembly for mercury containment
  - external fiducial registration for quick installation and replacement
  - constructed of commercially available components wherever possible
- Primary containment:
  - constructed out of commercial vacuum components
  - may be inerted, vented to atmosphere through mercury traps
  - pressure relief and liquid level sensors on mercury reservoirs
  - remote pneumatic operation, no active electrical components
  - interior is mercury wetted, all materials mercury compatible
  - can be isolated and pressurized for leak testing
  - beam windows are Inconel 718 and / or Havar

# Main Features of Pneumatic Mercury Jet Apparatus (2)

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- Secondary containment:
  - commercially fabricated out of welded stainless steel
  - air atmosphere, always vented to atmosphere through mercury traps
  - no active electrical components
  - interior is not mercury wetted, but all components are mercury compatible
  - interior can be manually sniffed for mercury
  - view ports are quartz or Lexan
  - approximate size: 20" wide x 20" high x 36" long

# Main Features of Pneumatic Mercury Jet Apparatus (3)

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- Mode of operation:
  - pneumatic operation and control to provide a 5-second duration mercury jet
  - two-dimensional positioning table is remotely controlled
  - remote operation of jet apparatus by computer control
  - minimize beam line entry requirements and radiation exposure
  - mercury sniffer on hand during operation
  - visual detection of mercury in secondary containment
  - all components are mercury compatible
  - radiation resistant materials such as poly-ether-ether-ketone valve seats, ethylene-propylene o-rings and Viton or copper flange gaskets are used
  - can reset for next test remotely in minutes



# Materials Considerations

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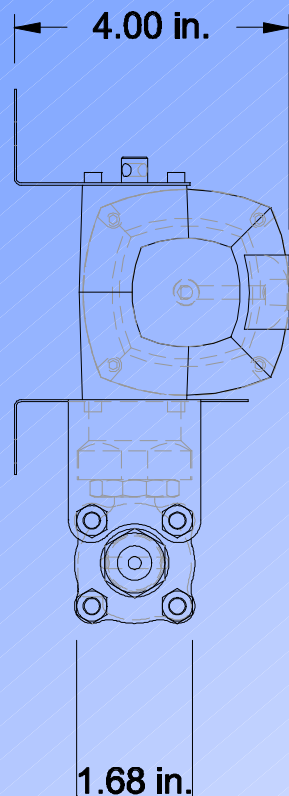
- Containments:

- commercially available stainless steel components for inner containment
- welded stainless steel sheet for outer containment
- Inconel-718 / Havar alloy external beam windows
- Quartz or Lexan internal view ports
- Quartz or Lexan external view ports

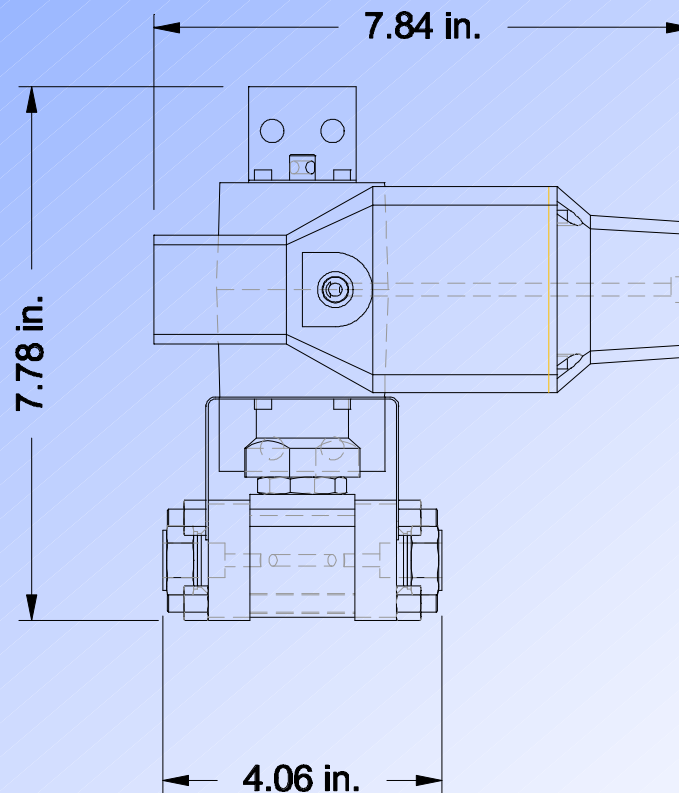
- Valves:

- stainless steel bodies
- Poly-Ether-Ether-Ketone seats
- Ethylene-Propylene or "grafoil" flange seals
- non-fluorocarbon actuators
- pressure ratings in excess of 1000 psig

# Pneumatically Actuated Ball Valve for Liquid Mercury



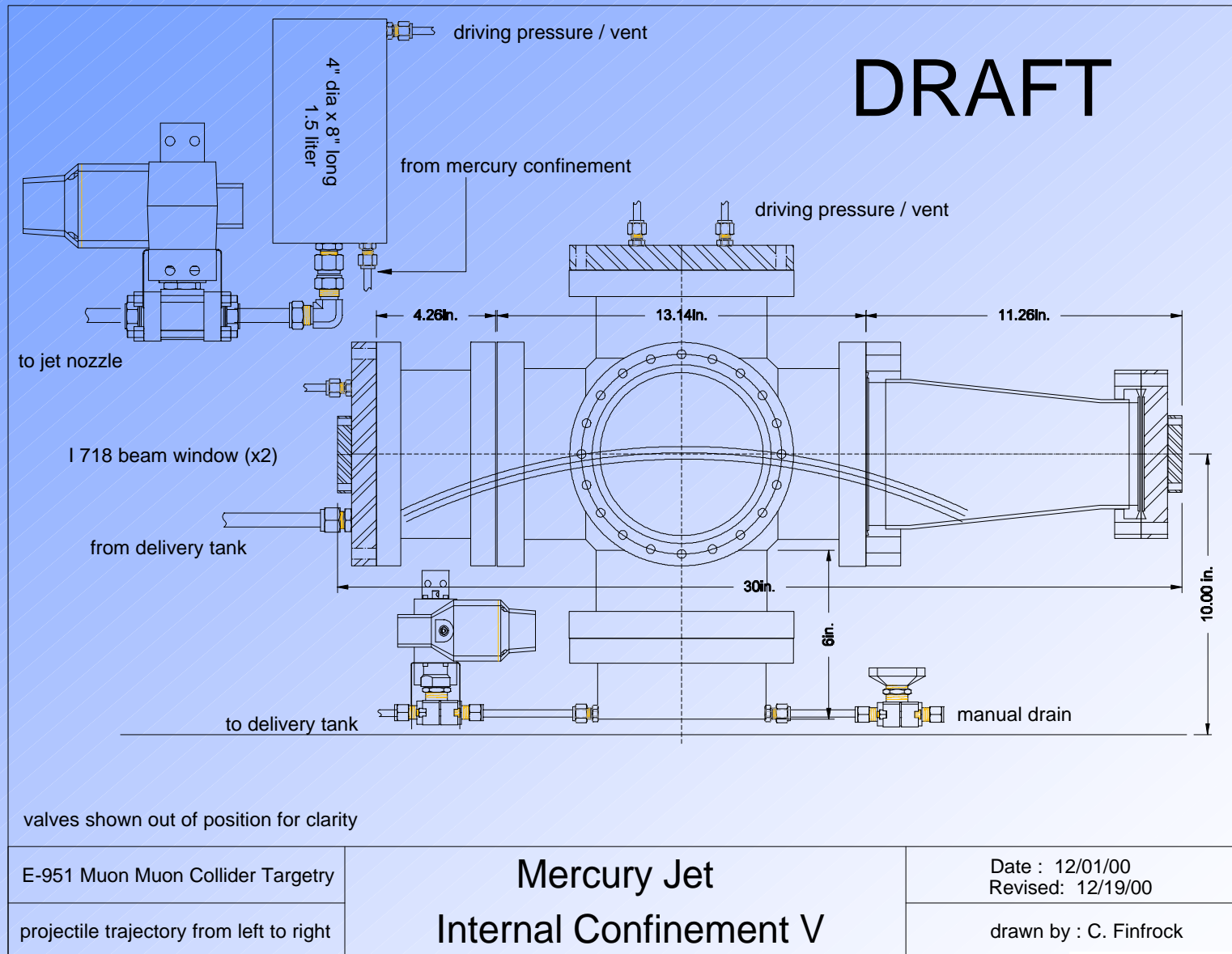
weight: 7.24 lbs  
body: stainless steel  
seats: teflon  
cost: \$391.10



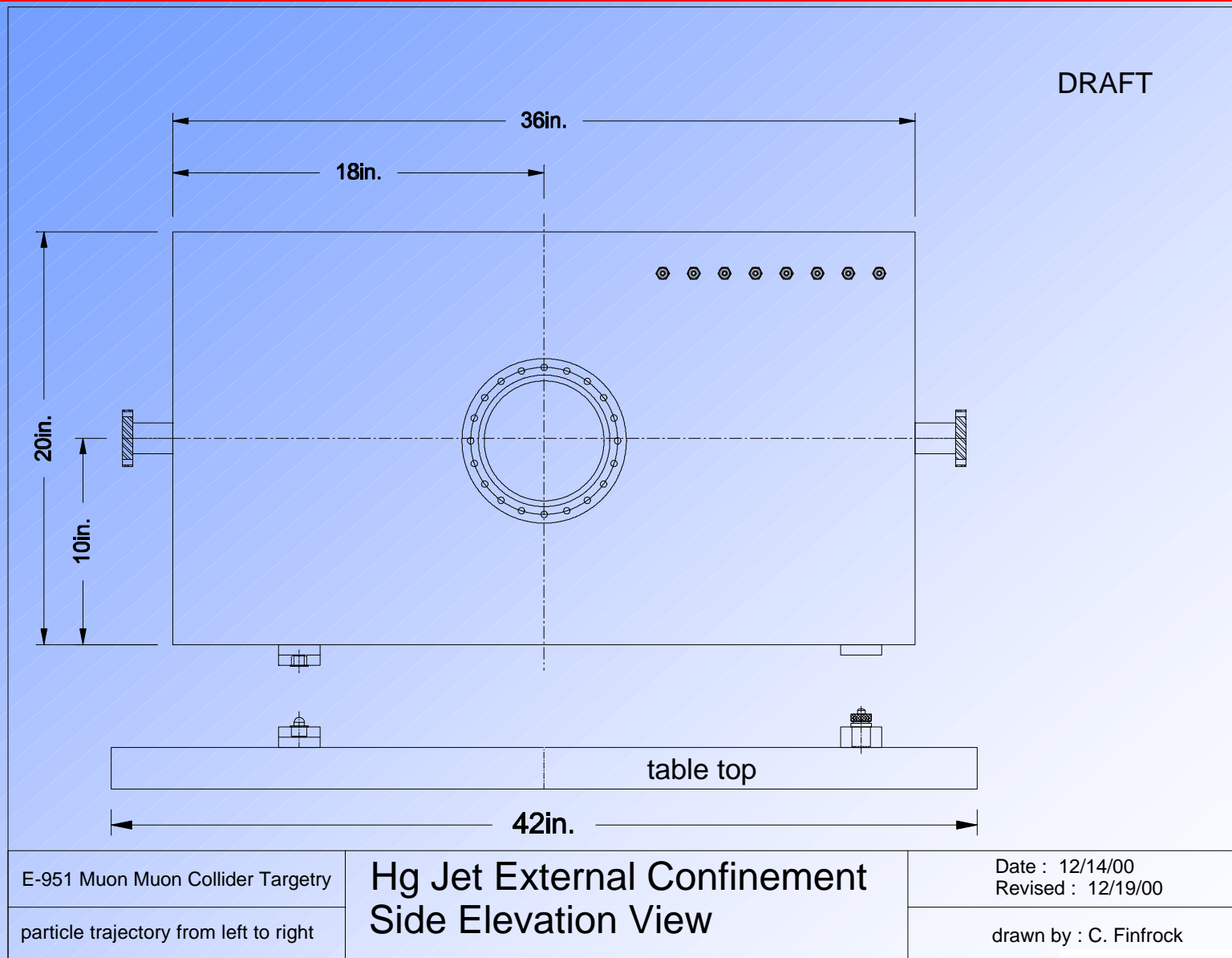
1/2 inch swagelok fittings  
rated 2200 psig from -20 to 100 F  
rated 800 psig at 300 F  
rated 100 psig at 450 F

E-951 Muon Muon Collider Targetry	Whitey "60" series valve with pneumatic actuator	Date : 11/17/00
part numberSS-63TS8-33C		prepared by : C. Finrock

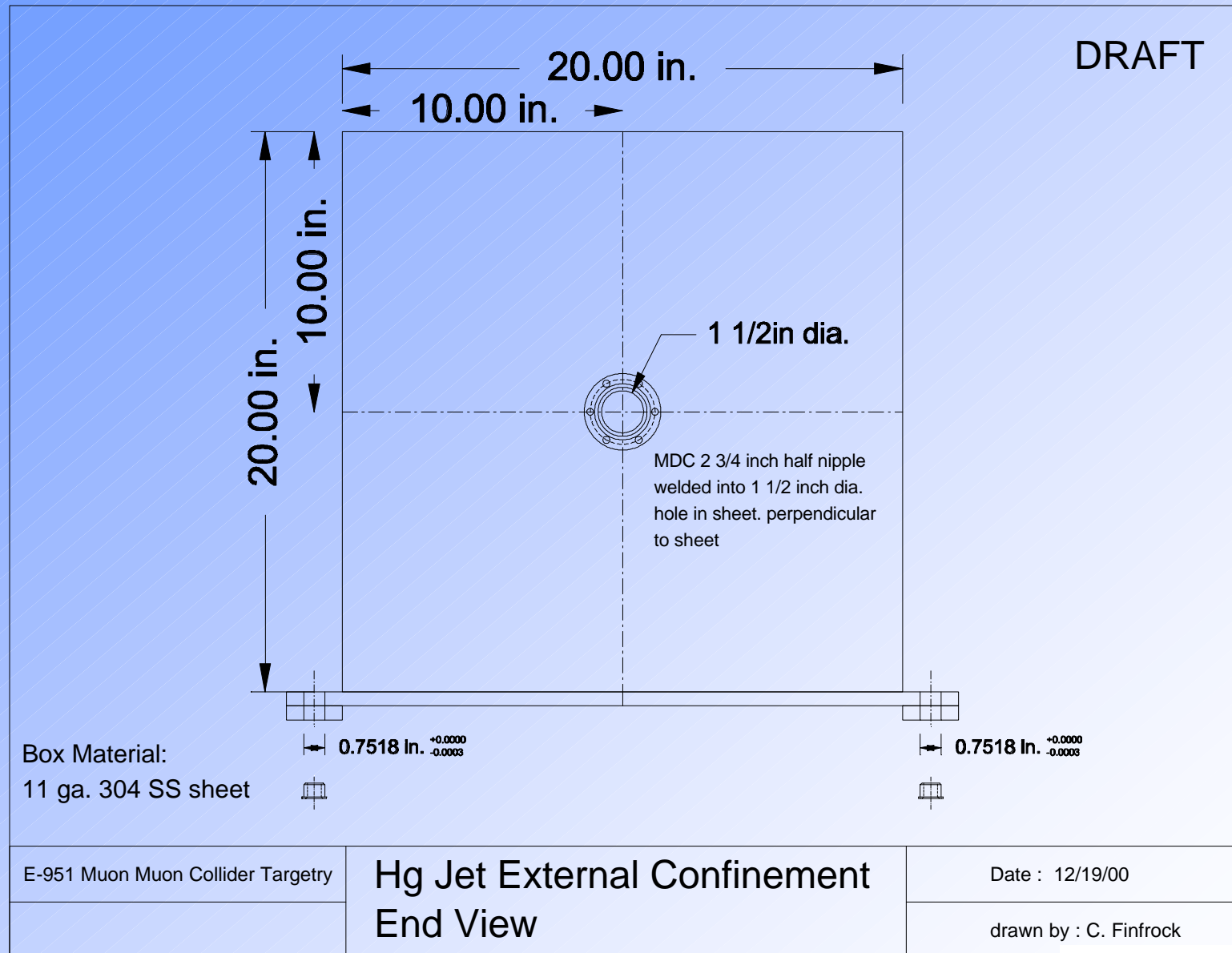
# Mercury Jet Internal Confinement, Integral Reservoir Design



# Side View of the Secondary Confinement

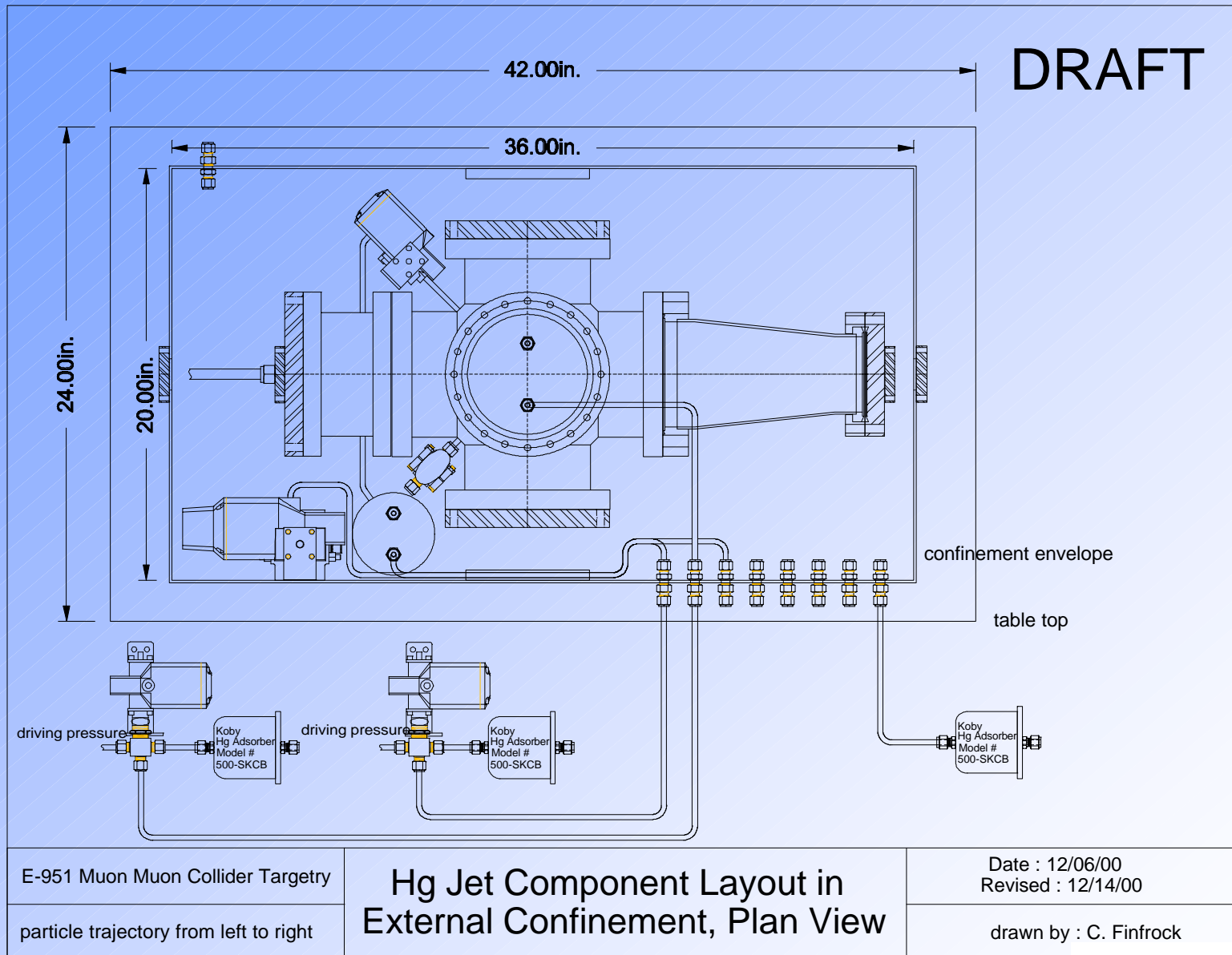


# End View of the Secondary Confinement

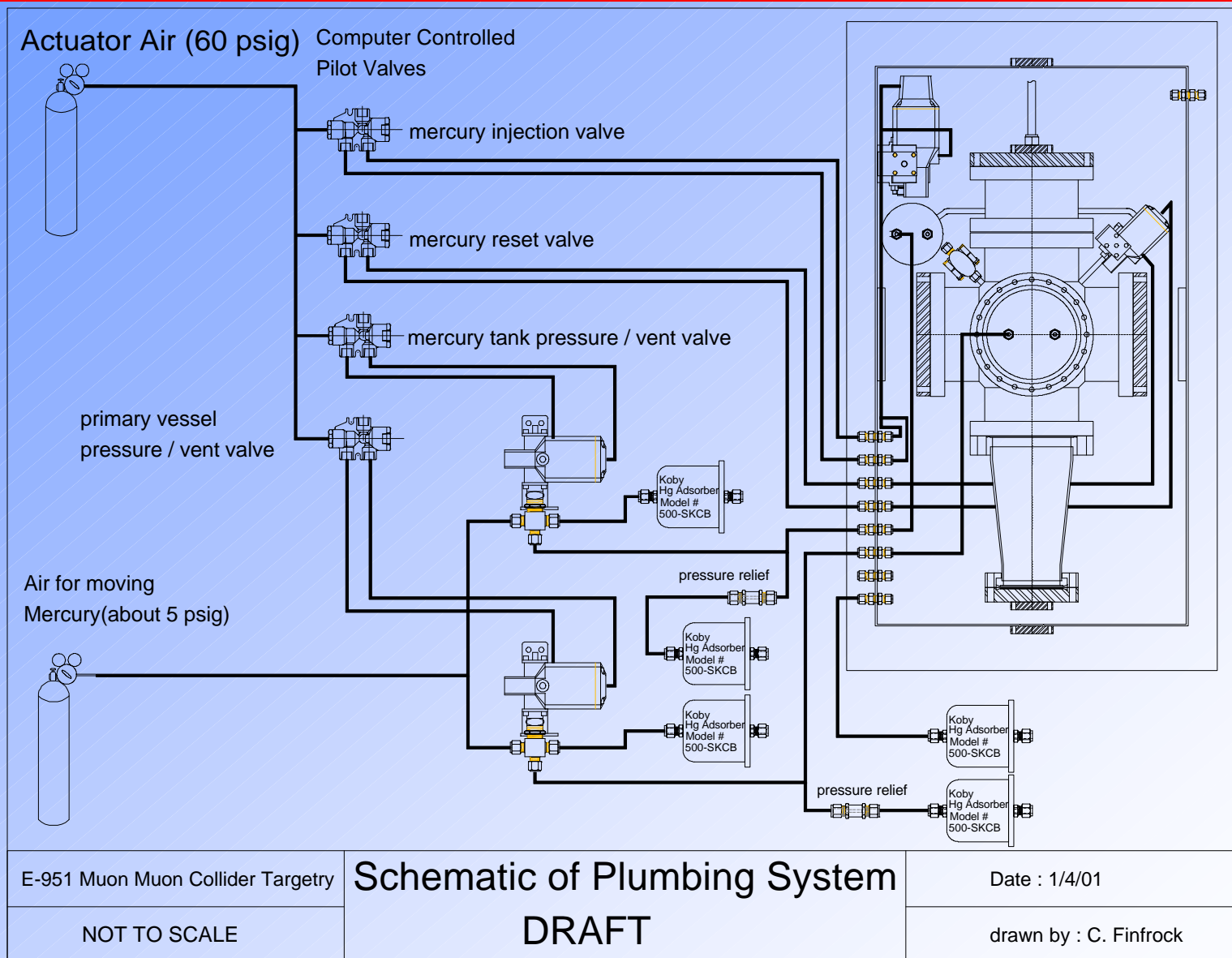




# Looking Into The Secondary Confinement From Above



# Pneumatic Control System for Mercury Jet

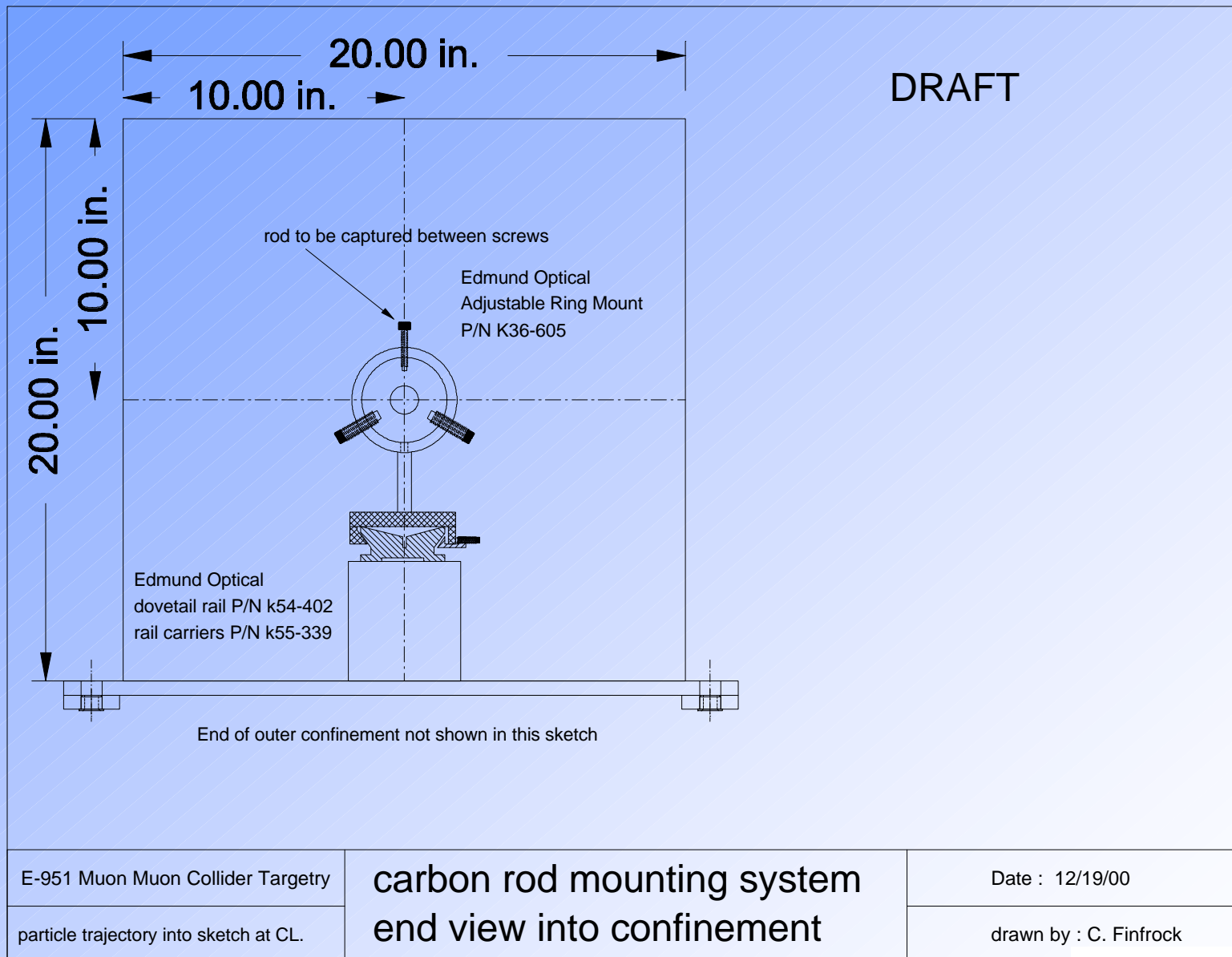


# Other Targets

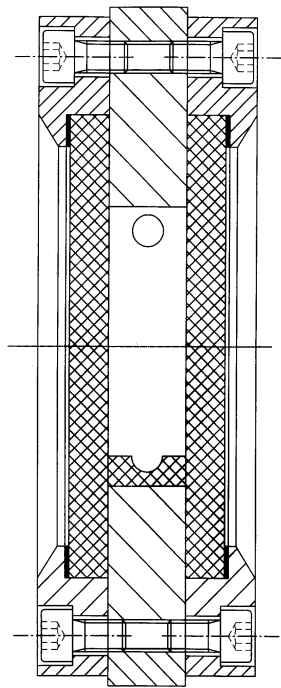
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- Carbon / Graphite Rod targets (ORNL)
  - Cylindrical solid rods up to 2.54 cm. dia. by 60 cm. long
  - Instrumented with fiber-optic strain gauges
  - Enclosed in external confinement similar to mercury jet test
- Static Mercury Target (CERN)
  - Enclosed in external confinement similar to mercury jet test
  - operates passively

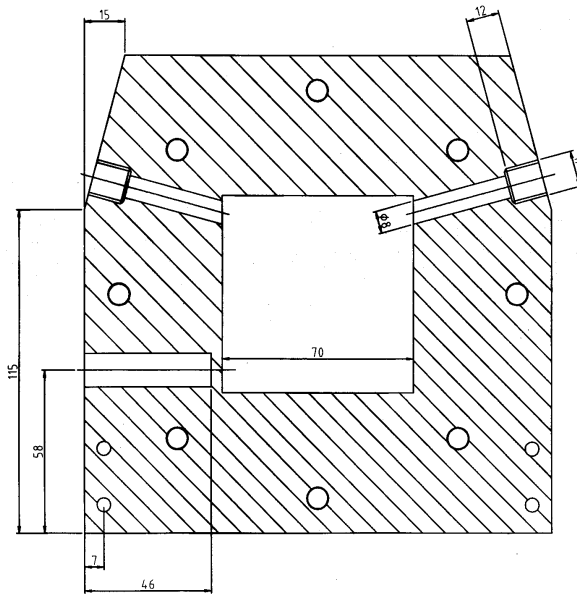
# Mounting System for Solid Cylindrical Targets



## The CERN Passive Hg Trough



Beamline View



Cross-section view



# Current Status

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- Water jet tests are complete.
- Mercury jet target designs are substantially complete, minor detailing still underway.
- Test stand is installed in the beam line.
- Materials list with prices and quotes about 85% complete. Ready to order many components now.
- Next step is to complete the experiment safety review, and begin target construction.